

WHAT IS CLAIMED IS:

1. A throttle valve opening and closing device comprising:

a throttle body for forming an intake passage led to an internal combustion engine;

a throttle valve rotatably mounted in the intake passage formed by said throttle body and changing an opening area of said intake passage to reduce the opening area when a flow rate of intake air is to be reduced, and to increase the opening area when the flow rate of intake air is to be increased;

a driving mechanism for driving said throttle valve to rotate such that, when said driving mechanism is operated in one direction, said throttle valve is rotated in one direction over an operating range;

a single return spring for generating a biasing force to return said throttle valve to one end of a movable range of said throttle valve when said driving mechanism generates no driving forces; and

an air passage defined by said intake passage and having a default position in which said throttle valve is located when a driving force from said driving mechanism does not act on said throttle valve, a position of a minimum opening area in which the opening area is minimized within the movable range of said throttle valve, and an operating range in which the opening area is gradually increased from the minimum opening area, the default position, the position

of the minimum opening area and the operating range being formed in successive order in a rotating direction of said driving mechanism and said throttle valve.

2. A throttle valve opening and closing device according to Claim 1, wherein first and second spherical recesses are formed a wall surface of said intake passage in a zone corresponding to the position of the minimum opening area in an opposed relation respectively to first and second outer peripheral edges of said throttle valve.

3. A throttle valve opening and closing device according to Claim 1, wherein said first and second spherical recesses are each formed to locate in a straddling relation to both the upstream and downstream sides of a position of a throttle shaft for supporting said throttle valve.

4. A throttle valve opening and closing device according to Claim 1, wherein corresponding to the default position, a groove is formed in a part of said second spherical recess formed in an opposed relation to the second outer peripheral edge of said throttle valve.

5. A throttle valve opening and closing device according to Claim 1, wherein the movable range of said throttle valve is the same as the operating range in which said driving mechanism and said throttle valve are operated

in one direction, one end of said range is defined as the default position, and the other end of said range is defined as a position of a maximum opening degree in which an opening degree is maximized.

6. A throttle valve opening and closing device according to Claim 5, wherein when said throttle valve is in the default position, the opening area of said intake passage with respect to said throttle valve has a value required for default operation of an engine, when said throttle valve is rotated toward the other end of said range and is in the position of the minimum opening area, the opening area has a value not larger than the value required for the default operation of the engine, and when said throttle valve is further rotated toward the other end of said range from the position of the minimum opening area, the opening area increases with the rotation of said throttle valve and is maximized at the other end of said range.

7. A throttle valve opening and closing device according to Claim 1, further comprising a control unit for controlling said driving mechanism such that, at the startup of an engine, said throttle valve is rotated from the default position up to a position beyond the position of the minimum opening area.

8. A throttle valve opening and closing device

according to Claim 1, further comprising a control unit for controlling said driving mechanism such that, upon detection of a failure of said throttle valve opening and closing device, said driving mechanism generates a driving force to rotate toward the position of the minimum opening area from the position of the maximum opening degree.

9. A throttle valve opening and closing device comprising:

a throttle body for forming an intake passage led to an internal combustion engine;

a throttle valve rotatably mounted in the intake passage formed by said throttle body and changing an opening area of the intake passage;

a driving mechanism for driving said throttle valve to rotate;

a single return spring for generating a biasing force to return said throttle valve to one end of a movable range of said throttle valve when said driving mechanism generates no driving forces; and

an air passage defined by intake passage and having a default position which is located at one end of a rotation range of said throttle valve driven by said driving mechanism and in which the opening area of said intake passage is larger than a minimum opening area, a position of a maximum opening area which is located at the other end of the rotation range of said throttle valve and in which the opening area of said intake passage is maximized, and a

position of the minimum opening area between the default position and the position of the maximum opening area.